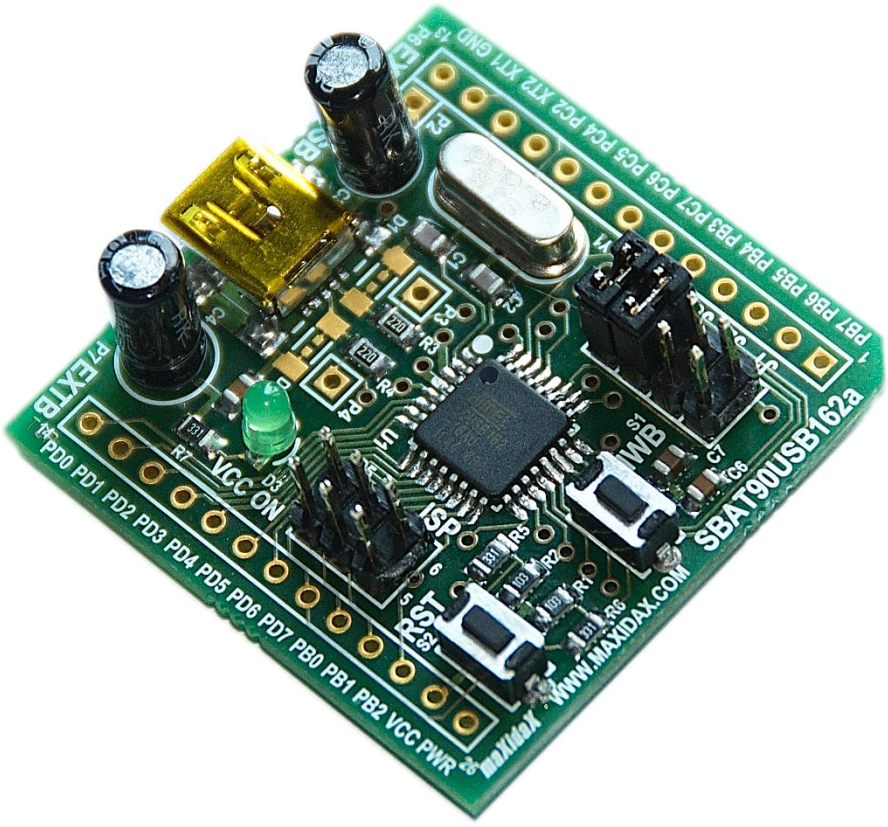
SBAT90USB162a

Atmel®
AT90USB162
Development Board

User's manual



1. INTRODUCTION

Thank you for choosing the SBAT90USB162a – Atmel® AT90USB162 development board. This board is designed to give a quick and cost-effective start to develop code and for hardware prototyping and testing.

1.1. OVERVIEW

This document describes the SBAT90USB162a development board – a cost-effective yet feature rich, flexible and easily configurable development tool, designed to allow easy coding and prototyping.

One of today's most widely used MCUs offering native USB support is the Atmel® AT90USB162. It provides an easy way to add USB functionality to any new design along with hundreds of different projects that are available.

The SBAT90USB162a is an Atmel® AT90USB162 development board. This board is a cost-effective yet feature-rich, highly compatible, flexible and easily configurable development tool, designed to give a quick start to develop code and for hardware prototyping and testing. It is a clean in design solution, but still providing configurability and flexibility not available with other products. The board provides all the basic circuitry needed to work with AT90USB162: USB connector and circuit, crystal, Reset and HWB buttons, power LED, power source/voltage configuration circuitry, ISP header.

The board offers flexible power configurable via jumpers: both 3.3 V and 5 V USB-powered or from external supply.

The board also features 100 mil headers, making it breadboard-friendly and easily connectable to any universal board or prototyping environment.

Board design makes it compatible with other similar development boards featuring same or similar MCUs and virtually all design/development software and libraries, including open source.

MCU comes pre-programmed with a bootloader allowing code to be programmed into the chip without any external programmer – simply by using FLIP software from Atmel. To enter the bootloader mode, the RST button should be pressed and hold, then the HWB button pressed and the RST button released.

An ISP programmer still can be used via dedicated ISP header, as well as debugger like JTAGICE via same header.

1.2. FEATURES

- Flexible power – 3.3 V or 5 V from USB bus or external 3.0 V to 5.5 V;
- All MCU I/O pins are accessible;
- 100 mil extension headers for connection to universal or breadboards, or direct interfacing with other devices, providing access to all I/O pins and virtually all signals;
- Mini USB connector – USB 2.0 full speed (12 Mbps) Device mode supported;
- Dedicated headers for USB signals: D-, D+, VBUS;
- Built-in 0.9..16 MHz crystal (default 8 MHz);
- Internal or external clock;
- Optional transient voltage suppression for USB data lines;
- Reset (RST) button;
- Hardware boot (HWB) button – allows forcing bootloader (stock Atmel® or third-party) execution at reset (see AT90USB162 datasheet) – allows MCU programming via USB without external programmer. I/O pin is still useable for other purposes;
- ISP (6-pin) connector supporting in-circuit programming and debugging via debugWIRE;
- FR-4 1.5 mm PCB with all terminals and components clearly marked, accepting TQFP-32, 7x7 mm body size, 0.8 mm lead pitch.

1.3. SPECIFICATIONS

Processor	AT90USB162
Max. clock frequency	8 MHz at 2.7 V, 16MHz at 4.5 V
Flash memory	16 kBytes (10,000 write cycles)
RAM	512 Bytes (static)
EEPROM	512 Bytes (100,000 write cycles)
USB	USB 2.0 full speed (12 Mbps) Device mode
USB DPRAM	176 Bytes
I/O lines	22
Timers	1 8-bit, 1 16-bit
PWM channels	5
USART	1
SPI port	1
Programming	Via USB and hardware-initiated bootloader or ISP connector
Debugging	Via debugWIRE interface (ISP connector)
Operating voltage	2.7 to 5.5V
Operating temperature	Industrial range -40°C to +85°C
Dimensions	38 x 38 mm (1.5 x 1.5 in) FR-4 1.5 mm
Weight	8.25 g

1.4. COMPATIBILITY

- As all MCU I/O pins are accessible and all MCU powering and clocking options are available the SBAT90USB162a is compatible with virtually every project and development tool designed for AT90USB162 and AVR MCUs.

1.5. OLDER VERSIONS

- Earlier version of this board was known as SBAT90USB162 and SBAT90UBS82162.

1.6. MCU OVERVIEW

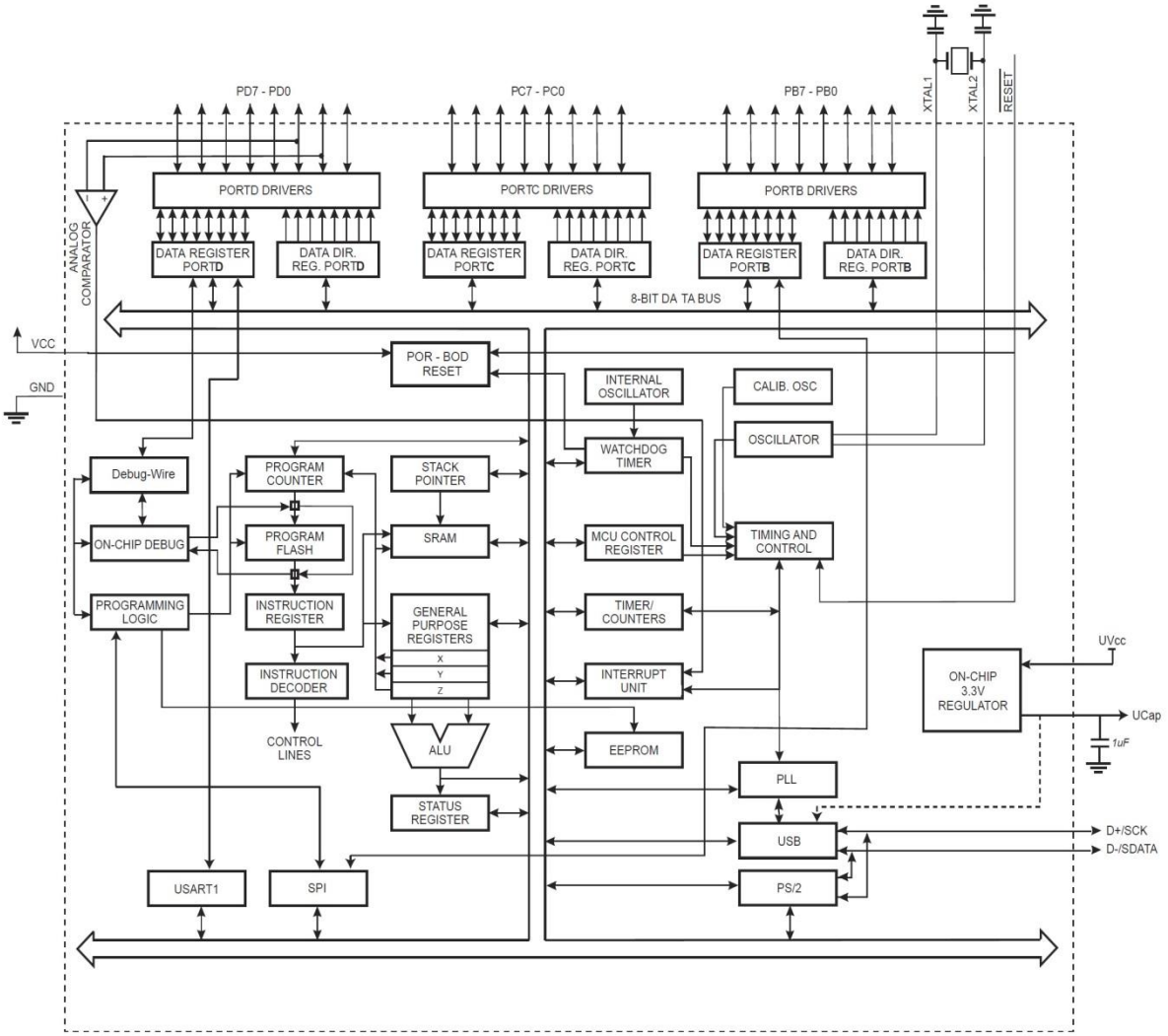
The AT90USB162 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the AT90USB162 achieves throughputs approaching 1 MIPS per MHz allowing optimization of power consumption versus processing speed.

1.6.1. Features

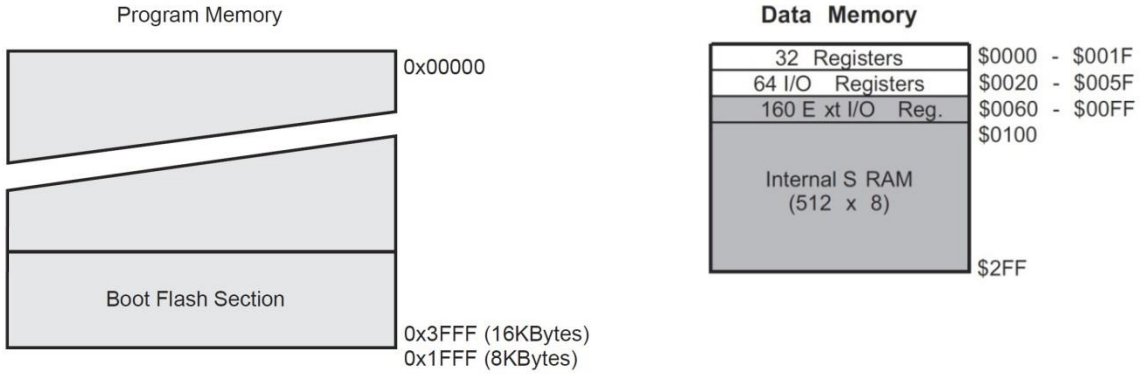
- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 125 Powerful Instructions
  - Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
- Non-volatile Program and Data Memories
  - 8K / 16K Bytes of In-System Self-Programmable Flash
    - Endurance: 10,000 Write/Erase Cycles
  - Optional Boot Code Section with Independent Lock Bits
    - USB boot-loader programmed by default in the factory
    - In-System Programming by on-chip Boot Program hardware-activated after reset
    - True Read-While-Write Operation
  - 512 Bytes EEPROM
    - Endurance: 100,000 Write/Erase Cycle
  - 512 Bytes Internal SRAM
  - Programming Lock for Software Security
- USB 2.0 Full-speed Device Module with Interrupt on Transfer Completion
  - Complies fully with Universal Serial Bus Specification REV 2.0
  - 48 MHz PLL for Full-speed Bus Operation: data transfer rates at 12 Mbit/s
  - Fully independent 176 bytes USB DPRAM for endpoint memory allocation
  - Endpoint 0 for Control Transfers: from 8 up to 64-bytes
  - 4 Programmable Endpoints:
    - IN or Out Directions
    - Bulk, Interrupt and Isochronous Transfers
    - Programmable maximum packet size from 8 to 64 bytes
    - Programmable single or double buffer
  - Suspend/Resume Interrupts
  - Microcontroller reset on USB Bus Reset without detach
  - USB Bus Disconnection on Microcontroller Request
  - USB pad multiplexed with PS/2 peripheral for single cable capability
- Peripheral Features
  - PS/2 compliant pad

  - One 8-bit Timer/Counters with Separate Prescaler and Compare Mode (two 8-bit PWM channels)
  - One 16-bit Timer/Counter with Separate Prescaler, Compare and Capture Mode (three 8-bit PWM channels)
  - USART with SPI master only mode and hardware flow control (RTS/CTS)
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- On Chip Debug Interface (debugWIRE)
- Special Microcontroller Features
  - Power-On Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Five Sleep Modes: Idle, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 22 Programmable I/O Lines
  - QFN32 (5x5 mm) / TQFP32 packages
- Operating Voltages
  - 2.7 - 5.5 V
- Operating temperature
  - Industrial (-40 °C to +85 °C)
- Maximum Frequency
  - 8 MHz at 2.7 V - Industrial range
  - 16 MHz at 4.5 V - Industrial range

1.6.2. Block diagram



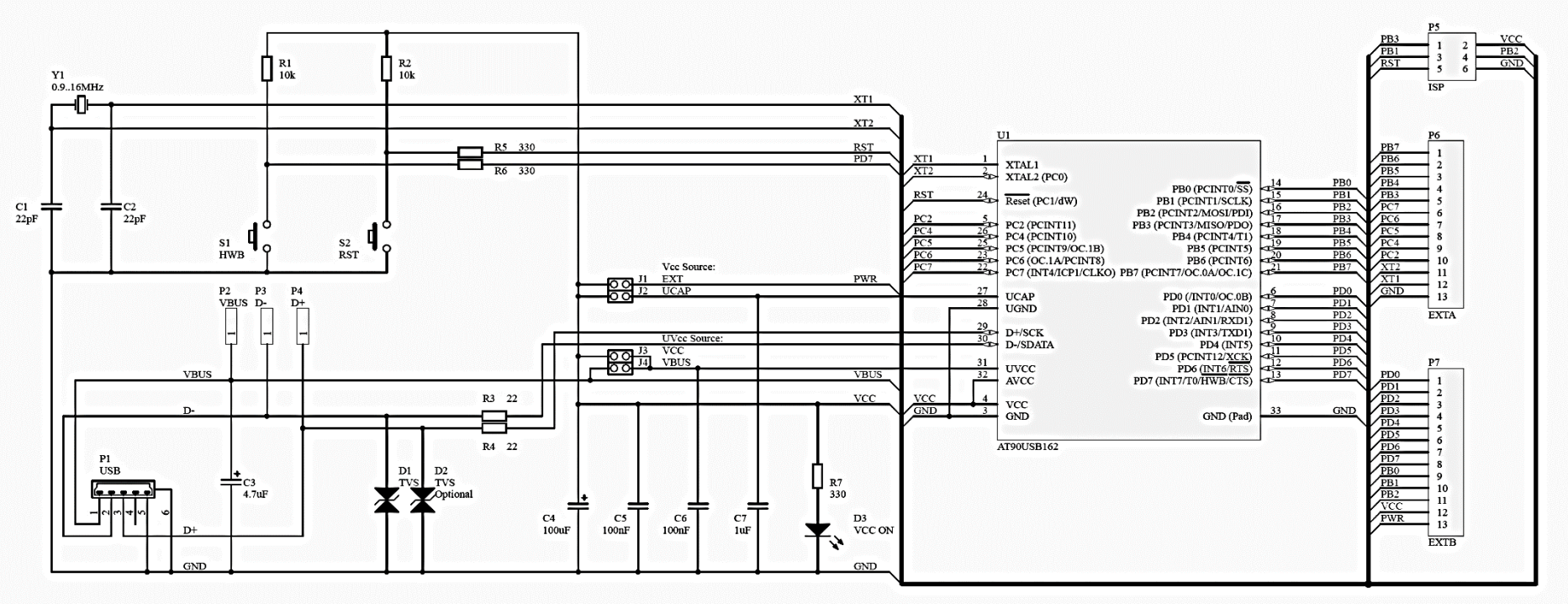
1.6.3. Memory map



2. USING THE SBAT90USB162a

This section describes the board and all its features

2.1. SCHEMATIC



2.2. BOARD DESCRIPTION AND CONFIGURATION

2.2.1. Clock

By default the clock is internal from 0.9..16 MHz[1] crystal oscillator, or internal calibrated RC oscillator. External[2] clock via XT1 (P6-12) is also possible. For using external clock CKSEL fuses must be programmed (see AT90USB162 datasheet).

Note: 1. Default is 8 MHz crystal, other is possible by request.
2. XT2 (PC0) can be used as generic I/O depending on MCU configuration.

2.2.2. Reset button (S2)

Cold reset can be done manually by RST button (S2).

2.2.3.HWB button (S1)

The hardware boot button allows forcing bootloader execution after reset (see AT90USB162 datasheet) thus allowing MCU programming via USB without external programmer. The HWB mode is active only when the HWBE fuse is enabled. In that case PD7/HWB pin is configured as input during reset and sampled during reset rising edge.

Programming via USB is based on pre-programmed USB bootloader, located in the on-chip boot section of the AT90USB162. This is the easiest and fastest way to reprogram the device directly over the USB interface, but with certain limitations. To force bootloader execution, operate as follows:

- Press both “RST” and “HWB” buttons;
- Release the “RST” button;
- Release the “HWB” button.

FLIP (Flexible In-system Programmer) is the software provided by Atmel® to do in-system programming of Flash devices through RS232, USB or CAN. For further details regarding programming via USB, please refer to FLIP documentation.

Note: In order to use FLIP, driver installation is required. USB drivers come with FLIP and can be found in its install folder. With Windows® operating system, depending on version used, digitally signed drivers might be required. As they may not be supplied by Atmel®, third-party signed drivers can be downloaded from the net. Maxidax Ltd. doesn't supply any drivers.

Tip: After programming is complete press the "RST" button.

Other bootloaders are also supported.

2.2.4. USB connector

Mini-B USB (P1)(1) is available.

USB Mini connector pinout:

Pin	Signal	Description
1	VCC	+5 V
2	D-	Data -
3	D+	Data +
4	ID	NC for type B
5	GND	Ground

USB signals are available via headers as follows:

Pin	Signal	Header
1	VBUS	
2	D-	
3	D+	

Note: 1. New, unprogrammed AT90USB162 device is seen via USB as "AT90USB162 DFU". To use USB driver installation is required. USB drivers can be downloaded from Atmel's site: http://atmel.com/*. Third-party drivers are also available on the net.

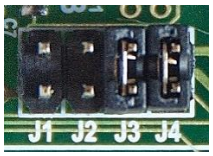
2.2.5. USB data lines transient voltage suppression

Data lines protection is available by using optional transils D1 and D2.

2.2.6. Power supply

Both 3.3 V and 5 V VCC power can be used, supplied either from USB or as self-powered device from external source via PWR (P7-13).

I/O voltage / VCC source	J1	J2	J3	J4
3 V I/O USB-powered	open	**short**	open	**short**
5 V I/O USB-powered	open	open	**short**	**short**
3.0 to 3.6 V I/O self-powered(1)	**short**	**short**	open	open
3.4 to 5.5 V I/O self-powered(2)	**short**	open	**short**	open

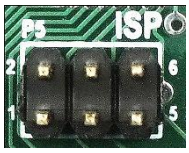


Note: 1. 3.0 V to 3.6 V can be supplied via PWR (P7-26);
2. 3.4 V to 5.5 V can be supplied via PWR (P7-26).

VCC presence, no matter what the power source is, is indicated by the green VCC ON LED (D3).

2.2.7.ISP connector

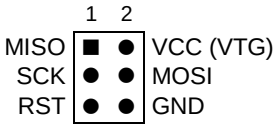
The ISP (6-pin) (P5) connector is intended for in-circuit programming and debugging via debugWIRE (RST pin). If this connectors is in use, it is not recommended (although is possible, by providing isolation resistors – see Atmel® AVR042: AVR Hardware Design Considerations) to use corresponding MCU pins as generic I/Os.



ISP connector is connected as follows:

ISP (6-pin)	In-circuit programming	Debugging via debugWIRE
Pin 3 SCK	X	
Pin 6 GND	X	X
Pin 1 MISO	X	
Pin 2 VCC	X	X
Pin 5 RST	X	X
Pin 4 MOSI	X	

ISP connector pinout:



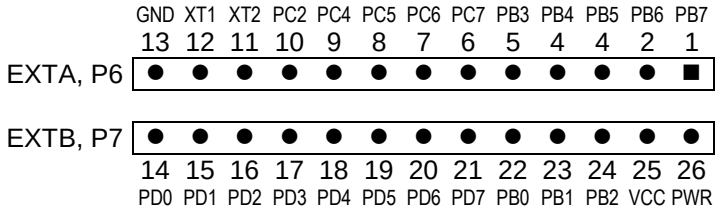
The debugWIRE interface uses only one pin, the RST pin, for communication with the target device. To enable the debugWIRE interface on an AVR device, the DWEN fuse must be programmed (DWEN = 0). AVR devices featuring debugWIRE are shipped with the DWEN fuse unprogrammed. ISP or High-Voltage Programming is required to enable debugWIRE.

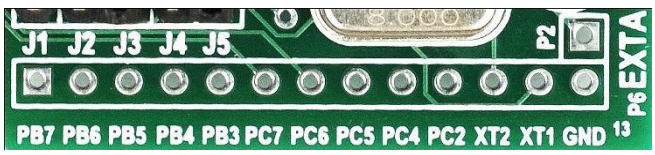
In order to use the ISP interface the SPIEN fuse must be programmed.

2.2.8.Extension headers EXTA, EXTB (P6, P7)

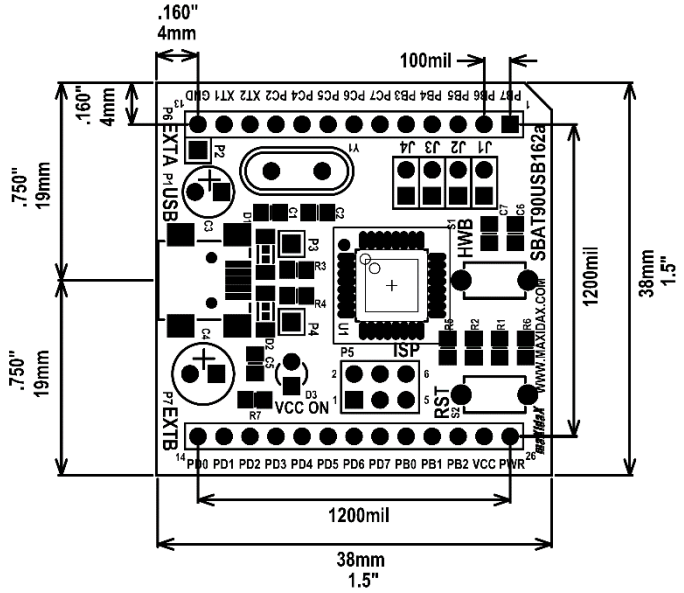
Extension headers provide connection to other devices and circuitry allowing access to all MCU I/O pins and other signals. EXTA and EXTB fit any 100mil/2.54mm linear connector, thus providing connectivity with virtually any 100mil/2.54mm universal or breadboard. Direct interfacing is of course also possible. Headers length and spacing between them is 1200mil/30.48mm (see BOARD LAYOUT AND DIMENSIONS).

Extension headers pinout:





3. BOARD LAYOUT AND DIMENSIONS



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